

TCS-2290-66  
24 March 1966

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## DESIGN OBJECTIVE

### ESTIMATING CROP YIELDS THROUGH AN ANALYSIS OF ORBITAL RECONNAISSANCE PHOTOGRAPHY.

1. INTRODUCTION. This research objective describes the requirements for a study effort to determine the feasibility of developing photo interpretation techniques and reference keys which would, ultimately, enable a trained interpreter to estimate wheat crop yields in selected areas of Russia and China through a study of aerial photography acquired at regular intervals over the croplands during the growing season. It would be desirable to make these crop yield estimates during the growing season. Because this is, of necessity, a research effort into a new area of photo interpretation the exact details of the proposed photo analysis program cannot be itemized very specifically in this design objective.

#### 2. BACKGROUND.

a. One of the major intelligence problems relating to agriculture in Communist countries is an evaluation of crop prospects and annual production achievements for the major crops. At the present time estimates are based primarily on such sources as current weather information, press reports for Communist countries, and, where possible, observations by US Embassy officials and other travelers. In the case of the USSR, much that appears in print about crop yields is exaggerated, while for Communist China very little information is reported in the news, or is available from other sources.

b. The crop yields of the USSR and Communist China not only play a large part in their internal economies, but determine to a large degree how much assistance these countries can give to the smaller nations which they are attempting to convert to Communism. It is believed, therefore, that for a number of years it will be important to know how successful these (and possibly other) countries are in meeting their goals in agriculture.

c. Preliminary conversations with experts in the field of aerial photography suggest that, given adequate R&D support, there may be some potential for developing new photographic techniques that would be useful in estimating crop types, acreages, and yields. A feasibility study is required to determine if this type of information can ultimately be obtained from KH photography.

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3. REQUIREMENTS.

a. Results Expected From the Study Effort.

It is anticipated that this study will lead to the development of interpretive techniques whereby photo interpreters can, through an analysis of photographic imagery acquired at regular intervals during the growing season, estimate wheat crop yields. Any such techniques developed must be applicable to the task of analyzing imagery comparable to that obtained from orbital photo reconnaissance systems even though the study effort itself need not utilize such imagery. The crop yield estimating techniques must be accurate within certain ranges of error and the results obtained must be verifiable.

The permissible range of error in the yield estimate will depend to a considerable extent on the time that the estimate is made. For example, in the case of winter wheat which is seeded in the fall and harvested the following summer, it would be useful to have an estimate early in the spring to give some measure as to how well the wheat survived the winter -- i.e., percentage of winterkill. At this stage even a qualitative estimate would be useful -- i.e., the stand is good or, alternatively, the stand has been reduced by 30% due to winterkill. In view of the fact that crop prospects must be reported throughout the growing season, crop estimates at various stages of growth during the spring and summer would be useful. An estimate at the critical "heading" period, for example, would be extremely useful. The permissible range of error in the yield estimate at this date, of course, would be somewhat greater than an estimate of the crop made just prior to harvest. A desirable goal would be a range of error of, +5% for an estimate at harvest time and, +15% for an estimate at the "heading" stage. In the initial stages of introducing a new method, a greater range of error would be quite acceptable and would be useful in checking and supplementing other methods of yield estimation.

b. Techniques by Which Desired Results Will Be Obtained.

The details of the proposed feasibility study effort are being left open intentionally. The Government is looking for creative ideas from responding contractors in this matter.

d. Planned Length of Study Effort.

The Government assumes that this study effort could be carried out within a 9- to 12-month time period.

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4. SECURITY. Only contractors with personnel and facilities cleared for TKH will be asked to submit proposals in response to this Design Objective. The analysts and researchers assigned to this study effort should be thoroughly familiar with the quality and nature of the imagery acquired currently by orbiting or very high altitude vehicles. This stipulation is made even though the bulk of the study might be carried out using unclassified photography which would be a simulation of operational imagery.

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